The Effect of Steam Deodorization on the Flavor Stability of Butteroil

Karen E. Nelson, James H. Vestal, Columbus Allen, and Owen Parks
Dairy Products Laboratory, Eastern Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture, Washington, D. C. 20250

SUMMARY

Five lots of butteroil were steam deodorized for 5 hr at 145°C and an absolute pressure of 0.02 mm Hg and stored, along with control butteroil, at −18°C and 27°C in a nitrogen atmosphere. Periodically, samples were homogenized into fresh skim milk and evaluated by a trained 10-member taste panel. Deodorized samples stored at 27°C received better flavor scores than control samples at 27°C but did not differ from control samples at −18°C.

INTRODUCTION

It has been reported (Keeney and Patton, 1956; Parks and Patton, 1961; Wong *et al.*, 1958) that lactones and methyl ketones contribute to the nonoxidative flavor deterioration of butterfat in evaporated and dry whole milk. Steam deodorization of butteroil has been claimed (Patton, 1964; Tharp, 1959) to be effective in producing and removing these flavor compounds so that dry whole milk made from the deodorized fat has better flavor stability in storage. This promising approach to flavor stabilization (stripping butteroil of its potential to form lactones and

methyl ketones) was studied to obtain more information on the effect of the steam deodorization process on the initial and storage flavors of butteroil.

EXPERIMENTAL

Pasteurized cream was churned in a Hamilton Beach mixer, model 30. The resulting butter was heated to 49°C, cooled, and held for 18 hr at 4°C, the separated butter serum was removed, and the butter was heated to 60°C and centrifuged twice to obtain a clear oil. The butteroil was stored at −18°C prior to processing.

Butteroil (520 ml) was steam deodorized for 5 hr in a laboratory deodorizer, described by Bailey and Feuge (1943) and modified by Baldwin (1948), at 145±5°C and an absolute pressure of 0.02 mm Hg with 27±5 ml steam, measured as water, bubbled through it. Then it was cooled under vacuum to 90°C and the vacuum broken with nitrogen. The deodorized butteroil and an equal quantity of untreated butteroil (control) were stripped with nitrogen for 7 min in glass ampoules, 16 ml per ampoule, sealed under nitrogen, and stored at both −18 and 27°C. The nitrogen stripping of the butteroil was accomplished at 100°F by inserting a fine glass capillary through the butteroil to the bottom of the ampoule. Nitrogen was introduced at a pressure to produce considerable agitation of butteroils.

Samples were removed from storage at intervals of 2 weeks for the first three months and then every month through 6 months for taste-panel evaluation. The 16-ml samples were recombined with 400 ml of fresh skim milk in a laboratory homogenizer at 63°C and 2500 psi and scored by a trained 10-member panel on the 31–40 point system proposed by the American Dairy Science Association scorecard committee (milk scoring 35 or above is considered an acceptable product).

The data were analyzed statistically by analysis of variance and Duncan's multiple-range test. Each tasting period was analyzed separately since the composition of the taste panel and the quality of the skim milk varied during the investigations.

RESULTS AND DISCUSSION

Table 1 lists the average flavor scores from 5 studies of deodorized and control butteroil samples through six months of storage at −18 and 27°C. With a few exceptions the steam-deodorized samples stored at 27°C scored one point higher than their corresponding control after 2 weeks and maintained this advantage through the entire storage period. Duncan's multiple-range test showed this to be a statistically significant difference. There was virtually no difference in score or flavor between the control samples stored at −18°C and the steam-deodorized samples stored at 27°C. Furthermore, little advantage was obtained by storing the deodorized samples at the lower temperature. Fig. 1 illustrates the effect of steam deodorization on the flavor stability of stored butteroil. The characteristic off-flavor of the samples stored at 27°C is of practical significance in that after 1 to 2 months of storage, the control samples were criticized for a definite or pronounced lactone flavor, whereas criticisms of the deodorized product were "slightly stale" or "slightly unclean" throughout the study.

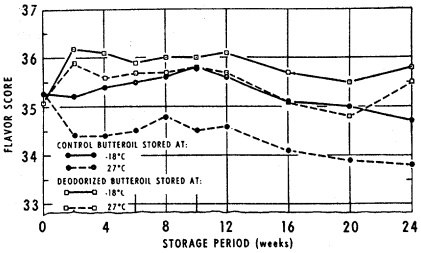

Fig. 1. Mean flavor scores of whole milks prepared from 5 lots of control and steam-deodorized butteroil samples during storage at −18 and 27°C.

The results show that the steam deodorization of butteroil can improve the flavor stability of butteroil against nonoxidative deterioration enough to eliminate the need for refrigerated storage. The deodorization conditions employed were established arbitrarily. Preliminary evidence indicates that a statistically significant improvement in the flavor stability of butteroil can be obtained after 2 hr of deodorization under the conditions employed.

Table 1. Average flavor scores on recombined whole milks prepared from steam-deodorized and control butteroils.

Lot no.	Treatment & storage temp. (°C)	Storage time (weeks)[a] Initial	2	4	6	8	10	12	16	20	24
1	Deod. −18°	35.1	35.9	36.1	35.9	36.0	36.7	36.2	36.0	35.1	36.5
	Deod. 27°		35.5	35.0	35.8	35.3	36.4	36.3	35.5	35.0	35.4
	Cont. −18°	34.1	34.0	34.8	35.0	35.6	35.7	35.1	35.1	34.4	34.7
	Cont. 27°		33.5	34.0	34.3	34.8	34.9	34.0	34.0	33.2	33.6
2	Deod. −18°	32.6	35.9	35.8	36.2	35.3	36.6	36.3	36.1	35.9	36.1
	Deod. 27°		35.8	35.4	34.8	35.7	36.0	35.2	35.7	34.2	35.1
	Cont. −18°	35.2	35.7	35.2	35.5	35.8	36.2	35.7	35.7	35.3	34.6
	Cont. 27°		34.1	34.0	34.0	35.6	34.5	34.5	34.5	34.4	34.0
3	Deod. −18°	35.9	36.6	36.1	35.7	36.8	36.1	36.4	36.6	35.9	35.3
	Deod. 27°		35.9	36.2	36.1	36.7	36.2	36.4	35.8	35.8	35.4
	Cont. −18°	35.9	35.7	35.9	36.4	36,3	36.6	35.8	35.9	35.6	35.1
	Cont. 27°		33.9	34.5	35.3	34.8	34.9	36.1	34.4	34.7	34.0
4	Deod. −18°	36.2	35.8	37.0	36.1	35.8	36.1	36.3	36.0	35.2	36.3
	Deod. 27°		36.1	36.1	36.2	35.4	36.0	35.8	35.3	34.6	35.9
	Cont. −18°	35.9	35.4	36.3	36.4	35.5	35.9	35.9	34.8	34.6	34.7
	Cont. 27°		35.6	35.8	34.6	34.9	34.6	34.8	33.6	34.0	33.9
5	Deod. −18°	35.7	36.4	35.6	35.6	36.3	34.6	35.0	34.0	35.2	34.7
	Deod. 27°		36.3	35.5	35.2	35.5	34.6	34.3	33.4	34.1	35.2
	Cont. −18°	35.6	35.5	35.2	34.3	34.9	34.5	35.2	33.8	34.8	34.2
	Cont. 27°		34.4	33.8	34.1	34.1	33.8	33.7	33.4	33.1	33.1

[a] Duncan's multiple-range test showed that the differences required for stastistical significance varied from 0.5 to 1.1 points, with an average of approximately 0.8 point.

REFERENCES

Bailey, A. E., and R. O. Feuge. 1943. Laboratory deodorizer for fats and oils. *Ind. Eng. Chem., Anal. Ed.* **15**, 280.

Baldwin, A. R. 1948. Effects of deodorization on the stability of vegetable oils. *J. Am. Oil Chemists' Soc.* **25**, 33.

Keeney, P. G., and S. Patton. 1956. Demonstration of delta decalactone in dried cream, dry whole and evaporated milk. *J. Dairy Sci.* **39**, 1114.

Parks, O. W., and S. Patton. 1961. Volatile carbonyl compounds in stored dry whole milk. *J. Dairy Sci.* **44**, 1.

Patton, S. 1964. Flavor stabilization of milk fat. U. S. Patent No. 3,127,275.

Tharp, B. W. 1959. The effect of deodorized milk fat on the flavor deterioration of dry whole milk. Ph.D. thesis. Pennsylvania State University.

Wong, N. P., S. Patton, and D. A. Forss. 1958. Methyl ketones in evaporated milk. *J. Dairy Sci.* **41**, 1699.

Ms. rec'd 2/23/65.

The mention of commercial items does not constitute an endorsement by the Department of Agriculture over other items of a similar nature not mentioned.

The authors thank Naomi Liming and the members of the taste panel for flavor evaluations of the samples, and Joe N. Boyd of Biometrical Services for statistical analysis of the data.